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[CHD 8: Occupational Safety, Health and Chemical Hazards]

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Indian Standard
CODE OF SAFETY FOR DINITROTOLUENE (DNT)

(First Reprint NOVEMBER 1996)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 3 *September* 1987

AMENDMENT NO. 1 DECEMBER 2006
TO
IS 12033 : 1986 CODE OF SAFETY FOR DINITROTOLUENE (DNT)

(*Page* 7, *clause* **4.1.1**) — Substitute the following for the existing text

'*TLV TWA* 0.2 mg/m^3 (ACGIH)
A3 — Confirmed animal carcinogen with unknown relevance to humans

(*Page* 7, *clause* **4.3.3**, *line* 2) — Substitute the following for the existing

'*Other effects* — Nonspecific effects such as reduced weight gain methemoglobinemia and effects on the central nervous system the reproductive system, and the bone marrow Carcinogenic '

(CHD 8)

Reprography Unit, BIS, New Delhi, India

Indian Standard

CODE OF SAFETY FOR DINITROTOLUENE (DNT)

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(*Continued on page* 12)

Indian Standard

CODE OF SAFETY FOR DINITROTOLUENE (DNT)

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 10 November 1986, after the draft finalized by the Chemical Hazards Sectional Committee, had been approved by the Chemical Division Council.

0.2 Dinitrotoluene (DNT) [$C_6H_3(NO_2)_2.CH_3$] exists in six isomers, the most important of them being 2, 4 — dinitrotoluene. It is used in the manufacture of explosives, for example, trinitrotoluene and dyes in organic synthesis.

0.3 Dye makers, explosives workers and organic chemical synthesizers are highly prone to inhalation of vapour and percutaneous absorption of liquid and, therefore, face a potential occupational exposure hazard while handling dinitrotoluene. The effects from exposure to dinitrotoluene are caused by its capacity to produce anoxia due to formation of methemoglobin. Cyanosis may occur with headache, irritability, dizziness, weakness, nausea, vomitting, dyspnea, drowsiness and unconsiousness. If treatment is not given promptly, death may occur. The onset symptoms may be delayed. The ingestion of alcohol may cause increased susceptibility. Repeated or prolonged exposure may cause anaemia.

0.4 Considerable assistance has been derived from the following publications in preparing this code of safety:

a) *Sittig* (*Marshall*) — Hazardous and toxic effect of industrial chemicals. 1979. Noyes Data Corporation, USA; and

b) *Sax* (*N. Irving*) — Dangerous properties of industrial materials 1979. Ed. 5. Van Nostrand Reinhold Company, New York.

0.5 DNT is a toxic and explosive substance. DNT confined in containers may explode in fire. But if stored or transported alongwith any explosive, DNT is considered as an explosive. When it is considered as an explosive, then instructions given in STEC Pamphlet No. 1 for storage and transport issued by Storage and Transport of Explosive Committee, Ministry of Defence, are to be followed.

1. SCOPE

1.1 This standard describes the properties of dinitrotoluene, nature of hazards associated with it; symptoms of toxicity, first aid, safety measures for controlling hazards in storage, handling and personal safety and essential information on packing and labelling.

2. TERMINOLOGY

2.1 For the purpose of this standard the definitions given in IS : 4155-1966* and IS : 4167-1980† shall apply.

3. GENERAL INFORMATION AND PROPERTIES

3.1 General Information

3.1.1 *Common Names* — Dinitrotoluene

3.1.2 *Chemical Names*

a) 2:3, 2:4, 2:5, 2:6, 3:4, 3:5 } Dinitrotoluene or Dinitrotoluol

b) 1-*methyl* — 2:4, 2:3, 2:5, 2:6, 3:4, 3:5 } Dinitrobenzene

3.1.3 *Empirical Formula* — $C_7H_6N_2O_4$.

3.1.4 *Molecular Formula* — $C_6H_3CH_3(NO_2)_2$.

3.1.5 *Molecular Weight* — 182·13.

3.2 Physical Properties

3.2.1 *Description, Colour, Odour and Physical State* — Orange, yellow solid-characteristic weak odour, 2:3, 2:4, 2:5, 2:6 and 3:4 isomers are needle shaped crystals, 3:5 isomer is in the form of monoclinic prisms.

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*Glossary of terms relating to chemical and radiation hazards, and hazardous chemicals.

†Glossary of terms relating to air pollution (*first revision*).

3.2.2 *Melting Point*

2:3 isomer — 61°—63°C
2:4 isomer — 70°C
2:5 isomer — 52·5°C
2:6 isomer — 60·5°—65·5°C
3:4 isomer — 60°—61°C
3:5 isomer — 92°—93°C

3.2.3 *Boiling Point*

2:3 isomer — data not available
2:4 isomer — slight decomposition at 300°C
2:5 isomer — data not available
2:6 isomer — do
3:4 isomer — do
3:5 isomer — sublimes

3.2.4 *Specific Gravity* — (Figure in the bracket indicates the temperature in °C)

2:3 isomer — 1·263 (111)
2:4 isomer — 1·321 (71) and 1·521 (15)
2:5 isomer — 1·282 (110)
2:6 isomer — 1·283 (110)
3:4 isomer — 1·259 (110)
3:5 isomer — 1·277 (110)

3.2.5 *Vapour Pressure* — For isomer 2:4

Millibar	*Temperature*
0·014	35°C
0·11	70°C (melting point)
0·83	100°C
8·50	150°C
50·50	200°C
225·0	250°C
300·0	300°C

Data of other isomers not available.

3.2.6 *Heat of Vapourization* — 3·9 × 10^5 J/kg.

3.2.7 *Miscibility/Solubility in Common Solvents* — *See* Table 1.

3.2.8 *Vapour Density* — 6·27 (air = 1·0).

3.3 Chemical Properties

3.3.1 *Affinity for Other Chemicals* — Dinitrotoluenes (DNT) are able to form molecular compounds with condensed ring aromatic dihydrocarbons and also with amines. DNT affects metals like tin and zinc. It reacts with oxidizers and caustics.

TABLE 1 MISCIBILITY/SOLUBILITY IN COMMON SOLVENTS

(*Clause* 3.2.7)

Isomer	Solubility in 100 Part of			
	Water	Alcohol	Ether	Carbondisulphide
2.3	←data not available→			
2:4	0·03 at 22°C	1·2 at 15°C	9 at 150°C	—
2:5	—	Very soluble	—	Very-soluble (*see* Note)
2:6	—	Soluble	—	—
3:4	Insoluble	Soluble	Soluble	2·2 at 17°C
3:5	Slightly soluble	Soluble when hot	Very soluble	Soluble

Note — Also very soluble in benzene.

3.3.2 *Stability at High Temperature* — Stable below 250°C, decomposes at 300°C.

3.3.3 *Flammable, Non-flammable or Supporter of Combustion* — DNT is combustible.

3.4 Fire and Explosion Hazard Properties

3.4.1 *Flash Point, Open Cup/Closed Cup* — 206·6°C closed cup.

3.4.2 *Ignition Temperature* — 260·0°C by heating small quantity at the rate of 5°C per minute.

3.4.3 *Explosives Limit Upper* — When dinitrotoluene is considered as an explosive the limits for storage shall be as per STEC pamphlet No. 1.

3.4.4 *Spontaneous Heating or Combustion* — DNT catches fire when subjected to prolonged heating or in contact with flame. It acts both as oxidizer as well as fuel.

3.4.5 *Shock Sensitivity* — DNT is relatively safe to handle. Precautions should, however, be taken that it is not subjected to blows or nipped between hard surfaces and it is not contaminated by grit which may increase its sensitiveness to shock.

3.5 Corrosion Properties — Being slightly acidic in nature, DNT may cause corrosion on ferrous material on long storage. It also effects metals like tin and zinc.

4. HEALTH EFFECTS AND TOXICITY INFORMATION

4.1 General — Dinitrotoluene has some effects and these are of similar character as observed with other aromatic nitro compounds but can manifest only after the absorption of larger quantities. Early symptoms resulting from exposure to this material include headache, fatigue, nausea and vomiting. More advanced symptoms are jaundice and secondary anaemia.

4.1.1 *Limiting Values for Health Hazards* — Threshold limit value or permissible limit of exposure, ceiling value, short-term permissible exposures are as follows:

a) Threshold limit value (skin*) — 1·5 mg/m^3 of air.

b) Short-term exposure limit (skin*) — 5·0 mg/m^3 of air.

c) Toxicity by ingestion — Oral LD 50 = 30 mg/kg (rat).

*Skin — refer to the potential contribution to the overall exposure by the cutaneous route including mucous membrane and eye, either by air borne or more particularly, by direct contact with the substance. Vehicles can alter skin absorption. The attention calling designation is intended to suggest of cutaneous absorption so that the threshold limit is not invalidated.

4.1.2 *Concentration Causing*

a) Eye irritation b) Respiratory irritation c) Skin irritation	These are early exposure symptoms above the threshold limit value of 1·5 mg/m^3 air.

4.1.3 *Concentation Immediately Dangerous to Life* — 200 mg/m^3 of air.

4.1.4 *Exposure Concentration Duration and Health Effects* — Late toxicity may cause liver damage, secondary anaemic neuritis and jaundice.

4.2 Routes of Entry

a) Respiratory, and

b) Skin.

4.3 Health Effects

4.3.1 *Eyes* — Acute, slight loss of colour, burning of eyes.

4.3.2 *Skin* — Chronic/acute, high burning of skin.

4.3.3 *Systemic* — Acute systemic, ingestion inhalation/skin absorption. Chromic systemic — same as acute systemic.

Nausea, headache, dizziness, drowsiness, collapse, loss of weight, fatigue, vomiting, marked chest pain, ingestion, over exposure to vapours from hot liquid or prolonged skin contact will cause these symptoms. Hypoxia, jaundice and anemia have been reported from chronic exposure.

4.3.3.1 *Organs or systems affected* — Eyes, liver, blood and cardiovascular system.

5. STORAGE, HANDLING AND TRANSPORT

5.1 Storage — Dinitrotoluene shall be stored in magazine but may be placed in an explosives store house (*see* Magazine Regulations Part 1— 1941). Storage shall be safe and effective preferably in mild steel drums (ungalvanized).

5.1.1 Usual modes of storage in bulk or in small quantities may be packed in steel drums usually of 25 litres capacity.

5.1.2 *Ventilation in Storage Areas* — Containers should be placed in a well ventilated place.

5.1.3 Floors shall be made only of wood or other non-sparking material and shall have no metal exposed.

5.1.4 *Electrical Fittings in Storage Area* — Light by portable electric storage lamps or by protected electrical systems or flood lights from outside of the magazine should be provided. Lamps should be vapour-proof type, switch should be outside the building and wiring should be through conduit, if electrically fitted.

5.1.5 *Fire Prevention Measures in Storage Areas* — Magazine should be kept clean. No combustible material should be left to accumulate in or around the magazine. Surrounding area of 7·5 metres preferably 15 metres shall be kept free of combustible material. Any flame, matches shall be avoided. High explosives to be stored in separate magazines. Only authorized persons should be allowed inside the magazine.

5.2 Handling — Since dinitrotoluene is a health hazard through skin contact, gloves shall be used while handling the chemical. In case of direct exposure in confined space, the operating personnel should wear personel protective equipment like self-contained breathing apparatus. The usual precautions of handling explosives is through avoidance, as far as possible, of impact, friction, ignition source, etc.

5.3 Transport — If DNT is transported with explosives, then it is treated as explosive and governed by statutory rules of the Explosive Safety Groups, Ministry of Defence (Government of India).

5.3.1 If transported along with substances other than explosives for purpose of transportation, DNT shall be treated as a poisonous (toxic) substance and appropriate rules of Red Tariff No. 19 followed.

6. FIRE PREVENTION AND FIRE FIGHTING

6.1 Types of Extinguishing Agents and Equipments which can be Used — Water, spray mist, vapouring liquid, dry chemical powder and carbon dioxide extinguisher.

6.2 Since dinitrotoluene is an explosive having moderate fire hazard when exposed to heat or flame, the usual precautions of providing flame/explosion proof, electrical equipment (*see* IS : 2148-1981*) and control on ignition source, namely, static charge/flame lights, as applicable to the explosives, shall be required.

In respect of fire fighting class (storage) it comes under category 3 of Government classification by Explosive Safety Group wherein the fire is fought at once without awaiting instructions in incipient stage. No attempt should be made to fight massive fires except for remote manual activation of installed fire extinguishing equipment or with unmanned fixed turrets and hose nozzles. The surrounding area should be evacuated.

7. SPILLAGE, LEAKAGE OF MATERIAL

7.1 Danger of Fire, Explosion, Toxic Exposure — Dinitrotoluene is combustible and poisonous gases may be produced in fire. Containers may explode in fire. It is poisonous, if skin is exposed. It burns skin and eyes.

7.2 Decontaminating Agents — Soap solution and water may be used immediately. Sulphite soap is preferable.

7.3 Facilities Required — Safety shower should be provided in the vicinity of storage and handling area. If the area covered is wide, it should be ensured that shower is quickly and easily accessible to all persons concerned or more number of showers may be provided depending upon the need.

8. WASTE DISPOSAL

8.1 Since dinitrotoluene is manufactured by nitration of toluene with a mixture of sulphuric acid and nitric acid, the waste will be acidic nitro compounds. The treatment of this waste can be through decomposition by both aeration and biological oxidation. Filtration through black garden soil can also remove the waste material to a great extent, but the most effective treatment on DNT will be with chlorine which will remove colour of the nitro compounds in a better way than the earlier methods. It can also be disposed by burning safely.

9. HAZARD INFORMATION

9.1 Dinitrotoluene has got both acute and chronic toxicity hazards. Suitable caution notice for such hazards may be displayed on a board

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*Flameproof enclosures of electrical apparatus (*second revision*).

near the plant for perusal by the people at work in the plant, for example,

'Vapour harmful
Harmful by skin absorption
Prevent contact with skin and eyes'

10. PERSONAL PROTECTION EQUIPMENT

10.1 Suggested Respiratory Protective Devices to be Used

Maximum Concentration	*Type of Respiratory Devices to be Used*
15 mg/m^3	Supplied air respirator or self-contained breathing apparatus
75 mg/m^3	Supplied air respirator with full face piece, helmet or hood
200 mg/m^3	Supplied air respirator with full face piece helmet or hood, pressure demand type or positive pressure mode type or continuous flow mode type
Escape	Gas mask with organic vapour canister with a particular filter or self-contained breathing apparatus

10.2 Suggested Non-Respiratory Protective Devices — Safety goggles and face shield, rubber gloves, boots and protective clothing shall be used by personnel. Protective clothing should be washed and changed after each work shift.

11. HEALTH MONITORING

11.1 Pre-employment examination of the personnel for allergic behaviour of nitrobodies exposure to be done. The exposed personnel in the dinitrotoluene plant should be periodically checked generally once in 3 months or at such intervals as may be directed by the appropriate authority, for haemoglobin and methemoglobin in their blood and records of blood examination are to be maintained in addition to the other acute and chronic toxicity-hazard, and signs and symptoms.

12. FIRST AID

12.1 Actions in Case of Affected Eyes — Thoroughly wash the eyes with large quantities of slow, running water from a tap or wash-bottle for 10 minutes. Ensure that the water bathes the eye-ball gently by opening the eye lids and keeping them apart till the treatment is complete, Also arrange for transport to hospital for immediate medical attention and treatment of eye injury. Detailed information regarding the accident should accompany the patient.

12.2 Actions in Case of Skin Contact — Wash profusely affected skin thoroughly with large quantities of running water for at least 10 minutes or till satisfied that no chemical is in contact with the skin. Use of soap will facilitate the removal of dinitrotoluene.

12.2.1 Remove all contaminated clothing of the casualty ensuring that the person removing is not contaminated during the prccess. If necessary, arrange for transport to a hospital or to a doctor for medical attention. Information regarding the accident along with details of first aid given should accompany the patient.

12.3 Actions in Case of Ingestion

12.3.1 If DNT is confined to the mouth, large quantities of water should be given as a mouth wash to the patient.

12.3.2 If the chemical has been swallowed dilute the chemical by given copious drinks of water or milk.

12.3.3 Do not induce vomiting.

12.3.4 Arrange for transport to hospital for medical attention. Information regarding the chemical swallowed, its concentration and quantity, if possible, along with the details of first aid given should accompany the patient.

(*Continued from page 2*)

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